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Procedia Environmental Sciences 17 (2013) 361 – 371

Procedia Environmental Sciences

The 3rd International Conference on Sustainable Future for Human Security SUSTAIN 2012

Community based approach for reducing vulnerability to natural hazards (cyclone, storm surges) in coastal belt of Bangladesh

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Abstract

The coastal morphology of Bangladesh influences the impact of natural hazards on the area. Especially, in the south-western area, natural hazards increase the vulnerability of the coastal dwellers and slow down the process of social and economic developments. There is a serious need for an effective disaster management plan to minimize the loss of lives and property. Unfortunately, the present cyclone warning signal is not only highly ineffective, but, sometimes also confusing. There is no comprehensive disaster management strategy. Some of the local NGOs in collaboration with government agencies undertake certain activities, but these too have been limited to mostly relief and rehabilitation. Cyclone preparedness plans are hardly found among these agencies. While it is not possible to prevent natural disasters, protective measures to reduce the vagaries of disasters can be evolved. Due to the unusual climatic behaviour in recent years, people in coastal areas face serious vulnerability, especially in the context of human settlements and consequently move out to the cities to combat the situation. These people need innovative strategies for survival. This paper assert, like many other newly devised coping strategies, that reducing vulnerabilities is important and suggest where innovation & adaptation is necessary to save communities from their vulnerability to climate change.

Selection and peer-review under responsibility of SUSTAIN conference's committee and supported by Kyoto University; (OPIR), (GCOE-ES), (GCOE-HSE), (CSEAS), (RISH), (GCOE-ARS) and (GSS) as co-hosts.

Keywords: Hazard; Risk; Vulnerability; Preparedness; Response; Mitigation.

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doi:10.1016/j.proenv.2013.02.049

1. Introduction

The coastal zone of Bangladesh hosts over 35 million people who are exposed to cyclones, storm surges, rough seas, salinity intrusion and permanent inundation due to rising sea level. There are 72 offshore islands with an area of 4,200 square km where over 3 million people are exposed and extremely vulnerable [16]. Unfortunately, the Bangladeshi coast is well-known for severe cyclones and cyclone-induced surges [1, 19, 24]. At least one major tropical cyclone strikes the Bangladesh coast each year [8, 17] with powerful tidal surges that impact hundreds of thousands people and make it more unsafe than many other regions in the world [18]. With the effects of natural hazards rising, in terms of loss of life and injuries in poorer nations [4, 11, 25], institutional disaster reduction approaches [5, 12] and approaches adaptable to individual social and livelihood experiences are required. Vulnerability factors have been central to the development of disaster research [9, 10, 14, 23, 24]. However, despite good progress in cyclone preparedness, exemplified by the existing comprehensive disaster management policies of the government of Bangladesh, localized vulnerability factors in cyclone hazards, arguably, remain only partly considered [2]. It is not enough to simply be prepared for a disaster. Countries likely to face future cyclones, like Bangladesh, need a longer term framework that strengthens the local people's capacity to adapt to climate change, particularly for weather-related disasters, such as cyclones and storm surges. So, it is necessary to analyze the community's vulnerability vis-à-vis to the climate scenario in Bangladesh's coastal areas.

The coastal areas of Bangladesh were chosen to trace the causes of vulnerability and to assess the ability of community to cope with vulnerability. The broader objective of the study was to deduce the proper option for action and planning to mitigate the vulnerability. The study was conducted in the following four local areas (*Upazila* or Sub-districts) of coastal region in Bangladesh.

1. Coxes Bazar, (Kutubdia *Upazila*)
2. Noakhali (Hatiya *Upazila*)
3. Bhola (Manpura *Upazila*)
4. Barguna (Patharghata *Upazila*)

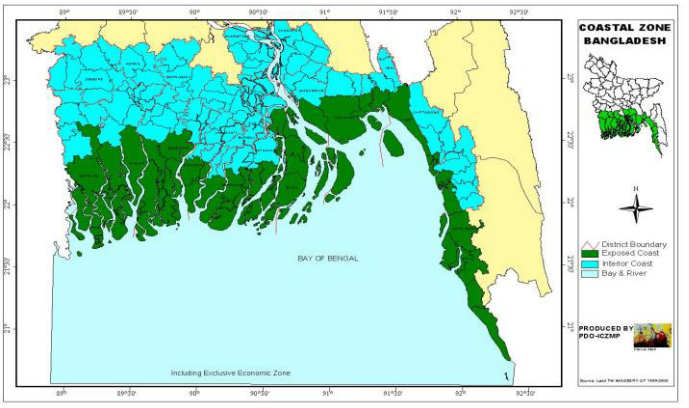

Figure: 1. Coastal Zone of Bangladesh

2. Sample size and methodology

Both quantitative & qualitative methods (using questionnaires) as well as focus group discussions (FGD) were used for the collection of data or information of the present study. Secondary data were also used in this study. The sample size of the present study was 385. A multi-stage sampling design was followed for selecting the final sampling unit (FSU). The first and the second stages adopted a purposive sampling method; while at the third and final stage, a systematic sampling method was employed.

3. Analytical framework

Vulnerability can be traced to environmental, socio-cultural aspects and the behaviour of the people, and physical aspects of the disaster risk-defined areas. And, so, this study adopts the following model for enquiry (figure: 1)

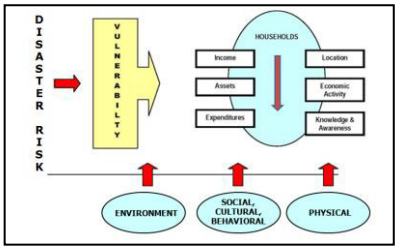

Fig. 2. Analytical framework

4. Analysis of data

4.1. Presence of hazards

The study found that the people in all survey areas were vulnerable to natural disasters. Due to the geographic location and the topographic composition of the areas in which they live, almost all respondents in the survey areas were exposed to cyclones, strong winds and storm surges that accompanied or resulted from the cyclone. Tidal surges had the greatest impact on homes, farms, fishing activities and small business, resulting in damages to property and assets and loss in income.

Table 1. Number of frequency happened of cyclone, storm surge in last 10 years.

Statistical Values	No. of time happened of cyclone	No. of time happened of storm surges
N	385	385
Mean	2.42	2.21
Median	3.00	2.00
Mode	3	2
Std. Deviation	.910	1.773

In the survey areas, 97.1% of households experienced cyclones and 76.4 % of households experienced tidal surges. Within the last 10 years, an average of 2.21 tidal/ storm surges and 2.41 cyclones affected these areas. Fortunately, in all of the survey areas, injury or death due to natural disasters has been negligible even though most of the respondents live close to bodies of water, like rivers and the sea. 96.9% of respondents felt that the frequency and intensity of natural hazards have been increasing recently; and, 96.6% of respondents considered that they were vulnerable to natural hazards and their perception of such vulnerability was increasing.

4.2. Household size and other characteristics

Respondents from the survey areas were large-sized households. On average, there were about six members per household with an average of two children, one of which was under 5 years of age; while those with household members who were over 6o years-old were very few. This shows that every

household has at least two members who may have special needs during and after disasters, especially during evacuation periods.

Table 2. Household size.

		Number of family member
N	Valid	385
Mean		5.63
Median		6.00

Table: 3. Age range 0-5 years household children

	Age 0-5 years household children
N	385
Mean	.70
Std. Deviation	.558
Sum	272

Table 4. Household perception about intensity of natural hazards over last three year.

Perception	Frequency	Percent (%)
Increasing	373	96.9
Decreasing	12	3.1
Total	385	100.0

In terms of occupation, 26 % of respondents in the surveyed areas were fishermen, 24.4% of respondents were farmers; 19% of respondents owned small businesses and 18.2% of respondents were day labours; while rickshaw derivers and those with government jobs were 3.1% and 1.8% respectively. The majority of the respondents' (44%) incomes per month were 5,000 to 8,000 Taka. On the other hand, only 13.2 % of the respondents' monthly incomes were more than 10,000 taka. The monthly average of household income was 7,393 taka.

Moreover, household expenditures were largely used for food averaged at 5,215 taka. Furthermore, children's education cost average was 903 taka and the medical treatment average was 781 taka. This did not leave much left over for households to generate savings. In total, the household per month average spending were 7,014 taka. Most of the respondents' households (62.9%) have no savings, while only 37.4% household have savings, which were mostly saved in banks (13.8 %), NGOs (9.9%), cooperatives (12.5%) and at home (1.6%), respectively. In addition, 77.4% of households have no insurance coverage; only 22.6% households have insurance, which was mostly life insurance (21%).

Table 5. Household occupation.

Occupation	Frequency	Percent (%)
Fisherman	100	26.0
Farmer	94	24.4
Day labour	70	18.2
Small business	73	19.0
Rickshaw driver	12	3.1
Govt. employee	7	1.8
Private sector employee	4	1.0
Teacher	4	1.0
Car driver	2	0.5
Others	19	4.9
Total	385	100.0

Table 6. Education qualification.

Qualification	Frequency	Percent (%)
No schooling	151	39.2
Primary	146	37.9
High School	62	16.1
College	25	6.5
University	1	.3
Total	385	100.0

Table 7. Monthly expenditure of household (Taka).

	Food expense	Education expense	Medical expense	Total expense
N	385	385	385	385
Mean	5215.84	903.69	781.04	7014.59
Median	5000.00	500.00	500.00	6500.00

Table 8. Household average of income (Taka).

	Income
N	385
Mean	7393.90
Median	6500.00

In terms of education, 39.2% of households never went to school. The primary, high school and college education completion rates were 37.9%, 16.1% and 6.5% per household, respectively. Within the households, those graduated from Universities were very few.

4.3. Housing condition

Housing units in all the survey areas were commonly made of mixed materials. Most of the house roofs were made of tin (62.9 %) and thatch (20.5 %), respectively; though, tin & thatch mixed (14.3 %) and Politian's were present as well (2.1 %). On the other hand, there were walls made of tin (31.7 %), bamboo (22.9 %), wood & tin (16.4 %), mud (19.2 %) and wood (4.4 %) respectively. However, a larger proportion of those who were poorer had dwellings that made of light materials. This type of housing, such as walls being made of wood and bamboo and thatch as a roof, was very vulnerable to strong winds. The poorer segments of the respondents who had this type of housing were the fishermen, tenant farmers and wage earners.

4.4. Adaptation of coping strategies

In every disaster-prone locality, people have some habitual coping strategies; but, the type of response and effectiveness of such strategies may vary over time and the coping ability may be overwhelmed by the scale of the disaster itself [7, 20].

Table 9. Household coping mechanism from cyclone & storm surges.

Coping mechanisms	Frequency	Percent (%)
By own savings	158	41.0
By borrowing money from relatives	126	32.7
By relief from the Government	71	18.4
By borrowing money from NGO	68	17.7
By relief from the NGO	59	15.3
By asking children to work	23	6.0
By borrowing money from Bank	12	3.1
By sold or mortgage assets	11	2.9
By stopping schooling of children	6	1.6
By reducing expenses on food and other household consumption	6	1.6
By migrating temporarily to other area	1	0.3
Total	385	100

Respondents in the survey have varying ways to cope with disasters. Most of the households (41%) coped with the effects of disasters by using personal savings, borrowed money from relatives (32.7%), relief budget from the government (18.4%), borrowed money from NGO is (17.7%), relief from the NGO is (15.3), asked children to work (6%), borrowed money from a bank (3.1%) and sold or mortgaged assets (2.9%), respectively. One coping mechanism was to stop the schooling of children to migrate temporarily to other areas, as well as to reduce the use of expenses on food and other household consumptions.

4.5. Informal risk sharing within the community

Despite the adoption of different strategies to cope with the disasters, vulnerability remains high in Bangladesh [6]. The study revealed that 68.6% of households trusted his / her neighbours very much. 24.2% trusted his /her neighbours somewhat and 6.2% little. On the other hand, households helped each other during cyclones and post-cyclone periods somewhat (40.5%), little (29.9%) and very much (24.2%), respectively.

Table 10. Level of trust toward neighbourhood/ relatives.

Household trust	Frequency	Percent (%)
Not trustful	4	1.0
Little	24	6.2
Somewhat	93	24.2
Very much	264	68.6
Total	385	100.0

Table 11. Level of neighbourhood help in case of your illness and natural disasters.

Household help	Frequency	Percent (%)
Somewhat	156	40.5
Little	115	29.9
Very much	93	24.2
Very unlikely	21	5.5
Total	385	100.0

4.6. Early warning, awareness, preparedness and mitigation

Response to cyclone warnings varies among the coastal people. Most of the respondents in the surveyed areas received disaster warning information from their radio, neighbours & kin as well as the Disaster Management Committee (DMC).The main source of warnings for disaster came from the Disaster Management Committee (60.8%), radio (22.3%), neighbours (13.2%) and television (2.9%), respectively. A few proportions received early warnings from their mobile phones. However, it is important to note that, in the study area, most of the households did not own a personal television, radio or mobile phone.

In terms of preparedness and mitigation, the respondents had several practices. In the surveyed areas, most of the respondents had a seemingly standard practice as far as preparedness was concerned. They tied rope to secure their houses (16%) when cyclones coming; moved to safer places (19%), moved assets to safer places (36%), prepared emergency kits (20%) and stockpiled food (9%), respectively. Nobody went to strengthen embankments or levees. Across survey areas, although the respondents were aware of and prepared for disasters, it must be noted that they were not involved in more community level activities, such as improving river embankments or levees. They considered such activity to be the responsibility of the local government units.

5. Summary

This study showed that a number of factors increased the vulnerability and risk of the target population. Findings of the study areas' qualitative and quantitative information summarized as follow:

First, foremost of the cause of vulnerability was the source of income of the household. Those dependent on farming, self employment, wage labour and fishing were the most vulnerable groups. The income derived from such activity was marginal and often uncertain. Therefore, the amount of income and sources of income could indicate the capacity of the people to afford physical mitigation and their capability to recover from disasters. Large incomes meant that people can build better houses, build savings or purchase insurance that cushion the impacts of disasters. On the other hand, some sources of income were very vulnerable to disasters such as cyclones. For instance, open sea fishing was dependent on the size of waves in the sea, which normally grow bigger during the cyclone and monsoon season.

Second, the quality of houses could approximate the risks that people faced from certain natural disasters, such as cyclones and tidal surges. Wooden and bamboo houses with thatched roofs could be easily destroyed (blown) by strong winds. The people were aware of these; however, a strong correlation was found between the type of housing families that they lived in and their income levels.

Third, scant financial resources hindered the fast recovery of the households from external shocks and crises, like calamities and disasters. They were unable to invest in preventive mechanisms, like repairing and improvement of houses, healthcare services, sanitation, children's education and a weakened ability to accumulate financial assets through savings. As a consequence, children's welfare and development were affected and sometimes sacrificed in order for the whole family to survive and got through a crisis. Children of vulnerable groups were more prone to stop going from school.

Fourth, the age and sex of household members were factors to determine vulnerability. Households with more children, more elderly or more women could experience more difficulties during evacuation and would require greater resources, like food and water after a disaster.

Fifth, the household composition and size were another contributory factor to a family's vulnerability. Households with large family sizes and a higher number of dependents, i.e., children and elderly, posed a big challenge to their recovery after a disaster. In the survey, families of farmers, wage labourers, the self employed and fishermen were found to have a high dependency ratio and bigger family size.

Sixth, level of education of the household head was another factor to their increased susceptibility to crisis and shocks. A majority of the target population have reached a basic education level (usually, up to primary school). Many of the vulnerable groups were found to be within this educational level and, hence, increased their risks.

Seventh, physical location of the households added to their risks and vulnerability. Risk exposure from cyclones was high in many areas and poor families who did not own a home or their lot often resided in dangerous areas, such as by the river side, along the beach areas or coastline and other low-lying marginal areas. This is further compounded by the fact that with their meagre income, they would not be able to build strong houses or to fortify them to reduce the risk of being damaged by cyclones, strong winds or tidal surges. Relocation was usually a long term solution for families in these areas; but it needed significant investment. Usually, this risk was managed by strengthening their social capital.

Eighth, the coastal and offshore inhabitants of areas near the Bay of Bengal often became isolated during cyclones; yet, they coped with these events due to knowledge passed down by previous generations. Although, people passively reacted to cyclone hazards before the event, during and after the cyclone and associated sea surges, they demonstrated a strong coping mechanism, including ensuring the survival of daily necessities through individual initiatives, kinship ties and obligations and social networking. These instinctive survival strategies (during and after a cyclone) have existed for generations and those played a significant role in people's ability to survive the disasters along the coastal areas of Bangladesh.

Ninth, due to the affection for domestic animals in these communities, concern about belongings in general and the loss of their only means of livelihood would make household heads to not choose to move to cyclone shelters easily. However, if the severity of the cyclone increased and warning signals mounted, the family, then, decided to go. By then, though, they might not be able to move because the wind and rainfall have increased. Besides the elements, trees uprooted by the wind could block access roads to cyclone shelters. A combination of rain and wind might damage or destroy earthen roads. Fear of injury by flying debris was another factor which made people hesitating from moving to cyclone shelters once winds gathered pace. In the worst cases, those who did not have any alternatives took shelter on the embankments, raised roads or other elevated places after the cyclone. Besides saving their own lives, people also tried to save poultry and livestock as these were the most valuable assets for rural communities.

Tenth, landownership, income and occupational status also had significant influence on the adaptation of coping measures. For example, landless and lower income groups had very small and risky portfolio of assets. Service and business households had a more stable income than daily labourers, fishermen or fry-collectors. Therefore, they had a higher capacity to procure food as well as a higher ability to capture forecast information to reduce disaster vulnerability.

Finally, moreover, this study found that the most exposed locations, such as islands and shoreline areas with a high frequency of cyclonic events, had negative influences on the inhabitants' coping ability. About, 5% of the respondents did not take any protective measures, with the belief that a cyclone is God's will and God would save them; it is beyond the control of people. This study also confirmed that indigenous coping strategies could significantly minimize cyclone vulnerability.

6. Recommendation

The coastal and island people generally increase their religious activities prior to a cyclone to satisfy their God. In this regard, future and alternative awareness can be generated among coastal communities of the nature of cyclones, such as by revealing the satellite imagery that detects cyclones to the local community level. Transport networks between settlements and cyclone shelters can also be improved to facilitate the movement of people and goods during disaster events.

Disaster risks can be reduced to rural populations through structural and non-structural interventions, empowerment of rural communities, improving awareness and planning, including the likely impacts of climate change. Therefore, improve overall disaster preparedness, response, recovery and mitigation by strengthening management capacity and coordination as well as networking facilities at all levels.

It is extremely important to promote disaster management planning with focus on the poor as a priority group for relief and rehabilitation. Government should be designed to adopt an umbrella program approach that encompasses all aspects of risk management and, in so, doing facilitates to move from a single agency response and relief strategy to a whole of government holistic strategy that addresses the issue of community vulnerability.

7. Conclusion

Bangladesh is one of the most disaster prone countries of the world, with extremely limited resources; its real development is not possible without the integration of disaster mitigation programs. The country is striving hard to establish an elaborated and experienced disaster management system from the national down to the community level to mitigate the effects of disasters.

The early warning system was implemented in Bangladesh after the 1970 cyclone (with 300,000 deaths); nonetheless, 138,000 people perished in the subsequent 1991 cyclone when most failed to respond to warnings, as well as a lack of shelters [22]. Now, it is widely believed that the Bangladesh Government's attempt to improve the early warning system has contributed to fewer deaths occurring in recent years [19]. In 2007, cyclone *Sidr* made landfall on southern Bangladesh, causing over 2,388 deaths and inflicting severe damage; in 2009, cyclone *Aila* caused 330 deaths [21].

The relief and recovery approach of disaster management in Bangladesh has been replaced by a holistic approach incorporating the process of hazard identification and mitigation, community preparedness and integrated response efforts [13]. Efforts are being implemented, targeting the strengthening of preparedness capacities and enhancing community resilience under the disaster risk reduction approach. The timely distribution of relief and undertaking rehabilitation activities in association with community support and response mechanisms can significantly contribute to the quick recovery from disaster shock.

Social capital (bonding & bridging), in particular, plays an interesting and complex role in Community Based Disaster Management. Like development management, effective disaster management requires participatory social organizations that promote cooperation and problem solving. However, even more than development, effective disaster management requires efficiency in decision making and implementation matters. Where communities are socially and economically marginalized, vulnerability is greater and an effective community based disaster management is limited [24]. Conversely, where a community is characterized by social and economic development, it is expected that vulnerability is minimized and the community's capacity to manage the event is greater.

Focusing disaster mitigation programs on an increasing adaptive capacity and lowering human sensitivity to natural hazards can also be a useful strategy in the context of other types of hazard events elsewhere. Reducing social vulnerability to hazards should always be the centre of any disaster mitigation policy because it is the most important factor that shapes the human experience with natural events. The lack of proper knowledge is a fundamental hurdle towards mitigating the damage by cyclones and tidal

surges in the coastal areas. In this case, this study hopefully will help the policy makers take immediate measures through the integrated planning and the building of awareness among the people of the coastal areas of Bangladesh.

Acknowledgment

This paper is based on a Doctoral thesis by Mansur Ahamed, which was supervised by Yukie Osa, Ph. D, Dr. Kiyoshi Kasahara and Sai Kurasawa. I would like to thank the Asian Institute for Intellectual Collaboration (AIIC) for their financial assistance.

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